

## VIII.6 Hydrogen Safety Panel

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- David J. Farese, Air Products and Chemicals, Inc., Allentown, PA
- Don Frikken, Becht Engineering, St. Louis, MO
- Richard A. Kallman, City of Santa Fe Springs, CA
- Michael Pero, Hydrogen Safety, LLC, Newington, CT
- Glenn W. Scheffler, GWS Solutions of Tolland, LLC, Tolland, CT
- Andrew J. Sherman, Powdermet Inc., Euclid, OH
- Edward G. Skolnik, Energetics, Inc., Columbia, MD
- Robert G. Zalosh, Firexplo, Worcester, MA

Project Start Date: FY 2004

Project End Date: Project continuation and direction determined annually in consultation with DOE

### Objectives

- Provide expertise and guidance to DOE and assist with identifying safety-related technical data gaps, best practices and lessons learned.
- Help DOE integrate safety planning into funded projects to ensure that all projects address and incorporate hydrogen and related safety practices.

### Technical Barriers

This project addresses the following technical barriers from the Hydrogen Safety section (3.8) of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

- (A) Limited Historical Database
- (B) Proprietary Data
- (C) Validity of Historical Data
- (D) Liability Issues
- (E) Variation in Standard Practice of Safety Assessments for Components and Energy Systems

- (F) Safety is Not Always Treated as a Continuous Process
- (G) Expense of Data Collection and Maintenance
- (H) Lack of Hydrogen Knowledge by Authorities Having Jurisdiction
- (I) Lack of Hydrogen Training Facilities for Emergency Responders

### Contribution to Achievement of DOE Hydrogen Safety Milestones

This project will contribute to achievement of the following DOE milestones from the Hydrogen Safety section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

- **Milestone 12:** Complete research needed to fill data gaps on hydrogen properties and behaviors. (2Q, 2010)
- **Milestone 20:** Update peer-reviewed Best Practices Handbook. (4Q, 2008)

Related milestones in Task 5 (Safety of DOE R&D Projects) of the above reference have all been previously achieved.

### Accomplishments

- Conducted two meetings of the Hydrogen Safety Panel: December 11-12, 2007, NASA White Sands Test Facility, Las Cruces, NM; June 24-25, 2008, National Renewable Energy Laboratory, Golden, CO.
- Conducted safety reviews for eight projects in hydrogen storage, production, fuel cells and technology validation and submitted reports to DOE per established protocol.
- Reviewed 40 safety plans since July 1, 2007 for projects in hydrogen storage, production and fuel cells.
- Completed *Safety Planning Guidance for Hydrogen Projects*, November 2007 which serves as a resource for project teams preparing safety plans as well as a statement of the DOE requirement.
- Provided technical guidance, source material and review for the Hydrogen Incident Reporting Database ([www.h2incidents.org](http://www.h2incidents.org)) and the Hydrogen Safety Best Practices Web site ([www.h2bestpractices.org](http://www.h2bestpractices.org)).



## Introduction

Safety is an essential element for realizing the “hydrogen economy” – safe operation in all of its aspects from hydrogen production through storage, distribution and use; from research, development and demonstration to commercialization. As such, safety is given paramount importance in all facets of the research, development and demonstration of the U.S DOE Hydrogen, Fuel Cells and Infrastructure Technologies Program Office.

Recognizing the nature of the DOE program and the importance of safety planning, the Hydrogen Safety Panel was formed in December 2003 to bring a broad cross-section of expertise from the industrial, government and academic sectors to help ensure the success of the program as a whole. The experience of the Panel resides in industrial hydrogen production and supply, hydrogen research and development and applications, process safety and engineering, materials technology, industrial liability and facility insurance, risk analysis, accident investigation and fire protection. The Panel provides expertise and guidance on safety-related issues and technical data gaps, reviews individual DOE-supported projects and their safety plans and explores ways to bring best practices and lessons learned to broadly benefit the DOE program.

## Approach

The Panel strives to raise safety consciousness most directly at the project level. Safety should be driven at the project level by organizational policies and procedures, safety culture and priority. Project safety plans are reviewed in order to encourage thorough and continuous attention to safety aspects of the specific work being conducted. Panel-conducted safety reviews focus on engagement, learning, knowledge sharing and active discussion of safety practices and lessons learned, rather than as audits or regulatory exercises. Through this approach, DOE and the Hydrogen Safety Panel are trying to achieve safe operation, handling and use of hydrogen and hydrogen systems for all DOE projects.

## Results

The Hydrogen Safety Panel was formed in fiscal year (FY) 2004 and the first meeting was held in Washington, DC, December 11-12, 2003. The Panel conducted its ninth and tenth meetings in FY 2008 as noted above. Current Panel membership is noted in Table 1.

Effective, July 1, 2008, Richard Kallman will succeed Don Frikken as chair of the Panel.

The Panel conducted project safety reviews since the last reporting as noted in Table 2; 31 such reviews have

**TABLE 1.** Hydrogen Safety Panel

|                                       |                                     |
|---------------------------------------|-------------------------------------|
| Don Frikken, Chair                    | Becht Engineering                   |
| Steven C. Weiner, Program Manager     | PNNL                                |
| Addison Bain                          | NASA (ret)                          |
| Harold Beeson                         | NASA White Sands Test Facility      |
| David J. Farese                       | Air Products and Chemicals, Inc.    |
| Richard A. Kallman                    | City of Santa Fe Springs, CA        |
| Michael Pero                          | Hydrogen Safety, LLC                |
| Harold L. Phillippi                   | ExxonMobil Research and Engineering |
| Glenn W. Scheffler                    | GWS Solutions of Tolland, LLC       |
| Andrew J. Sherman                     | Powdermet Inc.                      |
| Ian Sutherland                        | General Motors                      |
| Robert G. Zalosh                      | Firexplo                            |
| Nicholas F. Barilo, Technical Support | PNNL                                |
| Edward G. Skolnik, Technical Support  | Energetics, Inc.                    |

**TABLE 2.** Hydrogen Project Safety Reviews Since July 1, 2007

| Program Area                    | Project Title   | Contractor   |
|---------------------------------|---|--|
| Technology Validation           | California Hydrogen Infrastructure  | Air Products and University of California, Irvine, CA            |
| Technology Validation           | Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation   | Chevron Technology Ventures and AC Transit, Oakland, CA          |
| Fuel Cells, Storage, Production | Hydrogen Fuel Cells and Storage Technology; PEC and Solar Hydrogen Production                                     | University of Nevada Las Vegas, NV                               |
| Technology Validation           | Hydrogen Vehicle and Infrastructure Demonstration and Validation  | Shell Hydrogen and General Motors Benning Road, Washington, D.C. |
| Fuel Cells                      | Advanced Cathode Catalysts and Supports for PEM Fuel Cells; Membranes and MEAs for Dry, Hot Operating Conditions* | 3M Company St. Paul, MN  |
| Fuel Cells                      | Highly Dispersed Alloy Cathode Catalyst for Durability*   | UTC Power (and partners), South Windsor, CT                      |

\* conducted as telephone interviews

PEC - Photoelectrochemical

PEM - Proton exchange membrane

MEA - Membrane electrode assembly

been conducted since March 2004. The final report for Air Products' project has been submitted to DOE

with recommendations. Preliminary reports have been completed for the three other site visits and final reports with recommendations are in preparation and review.

In addition to reviewing safety plans, the Panel commended one additional safety plan to DOE as a “good example” for their reference and use: “Improved Membrane Materials for PEM Fuel Cell Applications” (University of Southern Mississippi). Four such safety plans have now been commended to DOE for those purposes.

DOE accepted the Panel’s recommendation and adopted *Safety Planning Guidance for Hydrogen Projects, November 2007*. This document incorporates a safety planning checklist, discussion, references for project teams and the DOE requirement for project safety plans.

### Conclusions and Future Directions

Being conscious of the need to use safe practices is a necessary first step for the conduct of all work. The work and approaches taken by the Panel will continue to focus on how safety knowledge, practices and lessons learned can be brought to bear on the safe conduct of project work.

The concept of a thematic and electronic safety bulletin for distribution to all project teams is being developed. The Panel will continue to serve as a resource for the development and review of new content for “H2BestPractices.org”. Additional emphasis will be placed on utilizing the Panel’s expertise to identify safety-related technical data gaps to benefit the DOE Hydrogen Program broadly. The 11<sup>th</sup> and 12<sup>th</sup> meetings of the Hydrogen Safety Panel are planned for December 2008 and June 2009, respectively.

### FY 2008 Publications/Presentations

1. Weiner, S.C., “Hydrogen Safety Panel: Safety Planning, Practices and Lessons Learned,” 2007 Hydrogen Codes and Standards Conference, NextEnergy Center, Detroit, MI, November 28, 2007, PNNL-SA-58049. <http://www.pnl.gov/energy/eed/policy-prog/pub.stm>.
2. Weiner, S.C., “Hydrogen Safety Awareness, Knowledge and Training,” DOE/Contractor Fire Safety Workshop, Office of Health, Safety and Security, Gaithersburg, MD, April 29, 2008, PNNL-SA-60225. <http://www.pnl.gov/energy/eed/policy-prog/pub.stm>.
3. Weiner S.C., “Hydrogen Safety Panel,” DOE Hydrogen Program Annual Merit Review, Arlington, VA, June 12, 2008, PNNL-SA-60080. [http://www.hydrogen.energy.gov/pdfs/review08/scs\\_6\\_weiner.pdf](http://www.hydrogen.energy.gov/pdfs/review08/scs_6_weiner.pdf).
4. Weiner, S.C. and Barilo, N.F., “Hydrogen Safety Panel: Shaping Safety Awareness and Practice,” 2008 Mary Kay O’Connor Process Safety Center International Symposium, College Station, TX, October 28-29, 2008. (abstract accepted)

### References

1. “Safety Planning Guidance for Hydrogen Projects, November 2007,” U.S. Department of Energy, Hydrogen, Fuel Cells & Infrastructure Technologies Program Office. (<http://www1.eere.energy.gov/hydrogenandfuelcells/codes/oversight.html>)